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Claims

587365 (35)

1. Method to denoise a stereo signal comprising a stereo sum signal and a stereo difference signal, **characterized by** a frequency selective stereo to mono blending based on the masking effect of the human auditory system.

2. Method according to claim 1, **chareacterized by** using noise included in the stereo audio signal as probe signal and an audio component of the audio signal as mask signal.

SUB A1

3. Method according to claim 1 or 2, **characterized by** determining the frequency selectivity by dividing the stereo difference signal into subbands.

4. Method according to claim 3, **characterized by** determining a number of subbands according to the properties of the human auditory system.

SUB A2

5. Method according to claim 3 or 4, **characterized by** determining a width of a respective subband according to the properties of the human auditory system.

6. Method according to claim 3, 4 or 5, **characterized by** attenuating every subband of the stereo difference signal which noise component lies above a signal component of a subband of the audio signal corresponding to that of the stereo difference signal so that the noise component of the subband of the stereo difference signal lies below the respective absolute value of masking.

7. Method according to claim 6, **characterized in that** an attenuation factor of a respective subband is determined by dividing the signal component of the subband of the audio signal corresponding to the subband of the stereo difference signal by the noise component of the subband of the stereo difference signal.

8. Method according to claim 7, **characterized by** limiting the attenuation factor of a respective subband to values between 0 and 1.

SUB A3

9. Method according to claim 7 or 8, **characterized by** subtracting a respective influence factor (K_0, ..., K_N) from the attenuation factor of a respec-

~~tive subband to reduce the influence of noise in the signal component to the attenuation signal.~~

SUB A3

~~10. Method according to anyone of claims 6 to 9, **characterized by** determining the noise component of a subband of the stereo difference signal on basis of its noise power which is determined by filtering an in quadrature component of the stereo difference signal into the respective subband and rms filtering the corresponding subband.~~

~~11. Method according to claim 10, **characterized by** determining the noise component of a subband of the stereo difference signal by weighting its noise power according to a respective corresponding absolute threshold of masking (M_0, ..., M_N), the fieldstrength of the received fm signal, a volume of output sound, a background noise level, the signal amplitude power of the audio signal, a speed of a vehicle whithin which the stereo signal is reproduced, and/or the ratio of the signal power to the noise power of the difference signal of the corresponding subband.~~

SUB A4

~~12. Method according to anyone of claims 6 to 11, **characterized by** determining the signal component corresponding to a subband of the stereo difference signal according to the fieldstrength of the received fm signal, a volume of output sound, a background noise level, the signal amplitude power of the audio signal, a speed of a vehicle whithin which the stereo signal is reproduced, and/or the ratio of the signal power to the noise power of the difference signal of the corresponding subband.~~

~~13. Method according to claim 12, **characterized by** weighting the squared subband signal of the in phase component of the stereo difference signal with a weighting factor (W_0, ..., W_N) according to the fieldstrength of the received fm signal, a volume of output sound, a background noise level, the signal amplitude power of the audio signal, a speed of a vehicle whithin which the stereo signal is reproduced, and/or the ratio of the signal power to the noise power of the difference signal of the corresponding subband.~~

SUB A5

~~14. Computer program product, comprising computer program means adapted to perform the method steps as defined in anyone of claims 1 to 13 when it is executed on a computer or digital signal processor.~~

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15. Stereo signal noise reducer, comprising a first filter bank (1) to split the stereo difference signal (l-r) into a plurality of subbands, respective first multipliers (2_0, ..., 2_N) to weight each of the subbands of the stereo difference signal with a respective corresponding control signal (C_0, ..., C_N), and a first adder (3) to sum all weighted subbands of the stereo difference signal (l-r) to build a frequency selective weighted stereo difference signal (diff), **characterized in that** a number and width of the subbands obtained via the first filter bank (1) are choosen according to the properties of the human auditory system, **and by** a weighting factor determination unit which determines a respective control signal (C_0, ..., C_N) frequency selective based on the masking effect of the human auditory system.

16. Noise reducer according to claim 15, **characterized in that** said weighting factor determination unit comprises
- a respective division unit (4) to determine a ratio of a signal component of each of the subbands of the audio signal corresponding to the subbands of the stereo difference signal to a noise component of each of the subbands of the stereo difference signal (l-r).

17. Noise reducer according to claim 16, **characterized in that** said weighting factor determination unit comprises
- a respective second adder (5_0, ..., 5_N) to determine the control signal (C_0, ..., C_N) by subtracting a respective influence factor (K_0, ..., K_N) from the output signal of the division unit (4) to reduce the influence of noise in the signal component to said control signal (C_0, ..., C_N).

Sub Ae

18. Noise reducer according to claim 15, 16 or 17, **characterized in that** said weighting factor determination unit comprises
- a mixer (6) and a first lowpass filter (7) to determine the noise component of the stereo difference signal (l-r) by deriving its in quadrature component, and
- a second filter bank (8) having the same characteristics as the first filter bank (1) to determine the noise component of each of the subbands of the stereo difference signal (l-r).

19. Noise reducer according to claim 18, **characterized in that** said weighting factor determination unit comprises
- a respective first rms determinator (9) receiving a respective output signal of

the second filter bank (8) to determine the respective noise power corresponding to the respective noise component of a subband of the stereo difference signal (l-r).

20. Noise reducer according to claim 19, **characterized in that** said weighting factor determination unit comprises
- a respective second multiplier (10_0, ..., 10_N) to determine the noise component of a subband of the stereo difference signal (l-r) by weighting the respective noise power according to a respective corresponding absolute threshold of masking (M_0, ..., M_N), the fieldstrength of the received fm signal, a volume of output sound, a background noise level, the signal amplitude power of the audio signal, a speed of a vehicle whithin which the stereo signal is reproduced, and/or the ratio of the signal power to the noise power of the difference signal of the corresponding subband.

21. Noise reducer according to anyone of claims 16 to 20, **characterized in that** said weighting factor determination unit comprises
- a third filter bank (11) having basically the same characteristics as the first filter bank (1) to determine the signal component of each of subbands of the stereo sum signal (l+r) corresponding to the subbands of the stereo difference signal (l-r).

22. Noise reducer according to claim 18, **characterized in that** said weighting factor determination unit comprises
- a respective second rms determinator (12_0, ..., 12_N) receiving respective corresponding output signals of the first filter bank (1), the third filter bank (11) or the first and third filter banks (1, 11) to determine the respective signal power corresponding to the signal component of each of the subbands of the stereo signal.

23. Noise reducer according to claim 22, **characterized in that** said weighting factor determination unit comprises
- a respective third multiplier (13_0, ..., 13_N) to determine the signal component of each of the subbands of the stereo signal by weighting the respective output signal of the first filterbank (1) with a weighting factor (W_0, ..., W_N) according to the fieldstrength of the received fm signal, a volume of output sound, a background noise level, the signal amplitude power of the audio signal, a

speed of a vehicle whithin which the stereo signal is reproduced, and/or the ratio of the signal power to the noise power of the difference signal of the corresponding subband.